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Canadian Society of Civil Engineers.

INCORPORATED 1887.

TRANSACTIONS.

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New York State

PENN YAN (N.Y.) WATERWORKS.

By Angus Smith, Stud. Can. Soc. C.E.

(To be read Thursday, 13th February, 1896.)

Penn Yan has a population of about 5,000. It is situated at the outlet of Lake Kenka in the western part of New York State, about 50 miles southeast from Rochester.

Lake Kenka is long and narrow, being about 20 miles long by ½ a mile wide, and it is very deep. It is from this lake that Penn Yan takes its water for fire and domestic purposes. At a distance of one mile up the lake from Penn Yan, the banks rise quite rapidly, so that it was easy to get a suitable place for a reservoir at a short distance from the lake, and at an elevation that would give good pressure for fire purposes.

At a distance of about 1½ miles up the lake from the town, it was decided to build a pump house on the shore, and extend an intake pipe out into the lake 550 feet, also to build a reservoir back 1800 feet from the shore and at an elevation of 320 feet above the surface of the lake.

Surveys, plans, specifications and estimates were made by the Engineer, estimating the entire cost for pumps, pump-house, reservoir, trenching, pipes, hydrants, etc., the whole system complete, to cost $60,000, which it did before completed.

The reservoir was located at such an elevation that ample pressure (90 lbs.) could be obtained in the higher parts of the town, for the town was built on an incline, as is shown by the contour lines in the plan.

The capacity of the reservoir was 1,000,000 gallons, which it was computed (in case of accident to the pumps) could be delivered to the centre of the town through the 12 inch pipe in 5 hours; this computation was made from the formulae

$$q = av = 0{\cdot}7854\ d^2 \sqrt{\frac{2gh}{1{\cdot}5 + f\frac{l}{d}}}$$

A 6 inch overflow pipe was put in the reservoir 2 feet from the top of wall, and conveyed the water 75 feet from the reservoir. This pipe was computed to carry off 850,000 gals. daily before the water would overflow the walls.

The following are some of the specifications:—The trenches were 5 feet deep, and, where possible, made in a straight line, were kept dry and made wide enough that the laying and caulking could be properly done, care being taken not to injure gas, water, or sewer pipes already laid.

The boxes for stop gates were placed vertically over and around the top of the gate, and then surrounded for a thickness of about 1 foot with small loose stones or coarse gravel, which was carried up to within 20 inches of the grade of the street. Upon this mass of loose stone or gravel a sufficient amount of fine gravel was then deposited to form a bed for the gate-box stone into which the jacket inclosing the upper portion of the box is suspended.

Every pipe, special casting, stop gate and hydrant was firmly supported and adjusted to the required alignment and grade by a wooden block and two wooden wedges, which were in general placed near the hubs of the pipe and fixtures. The blocks were of sound hemlock or oak, not less than 16 inches long, 3 inches thick, and 9 inches wide, the wedges were 10 inches long, 4 inches wide, and 3 inches thick, these blocks were evenly sawed, and remained under the pipe after refilling the trench.

The spigots were inserted into the hubs, so that the shoulder of the hub was in close contact with the face of the spigot, and were then adjusted by the wedges so as to give an even and uniform space all around for the lead joints.

Hemp yarn was securely driven into the joints, so as to leave $2\frac{1}{2}$ inches in depth and at least $\frac{5}{16}$ of an inch in thickness all around for the lead. The yarning and caulking was performed by faithful and competent mechanics.

The cutting of the pipe was done by sharp cold chisels, the cut being first distinctly marked all around and then carefully followed by the chisels.

The hydrants were set upon a large wooden block bedded securely in the bottom of the trench, at such a depth as that the top of the jacket surrounding the hydrant was about $1\frac{1}{2}$ inches above the sidewalk; the stop gates were also set firmly upon these blocks.

Iron plugs and caps were leaded and caulked into the dead ends of the lateral pipes, and behind these plugs, rubble masonry was laid in cement, reaching from the plug to the end of the trench.

The pipes were each 12 feet long, and were free from scoria, sand holes and air bubbles, and were clean in all respects. They had to pass a careful hammer inspection under the direction of the Engineer or his assistants, and thereafter were subject to a proof test by water pressure of 300 lbs. to the sq. inch.

The pumping engines consisted of two duplex, compound, non-condensing engines, each capable of delivering 750,000 gals. daily at a piston speed of 100 feet per minute with 80 lbs. of steam. The floor of the engine room was 17 feet above the surface of the water in Kenka Lake.

The force main was 10 inches diameter for a length of 200 feet connecting with a 12 inch main to the reservoir, 1600 feet away and 300 feet above the engine room.

The boiler was of homogeneous steel in 3 courses, each course in one sheet $\frac{3}{8}$ of an inch thick and with a tensile strength of 60,000 lbs. per sqr. inch. The boiler was 14 feet long and 5 feet in diameter.

The intake pipe commenced 2 feet outside of the wall of the pump house, and for 150 feet consisted of 10 inch cast iron pipe weighing 50 pounds per lineal foot, laid the same as other cast iron pipe, connecting with the lake end of this pipe were about 400 feet of standard wrought iron, lap-welded water pipe 10 inch internal diameter and 0.366 of an inch in thickness of shell, with an average weight of 40 pounds per foot, this pipe was coated inside and outside with a coating similar to that used on the cast iron pipe.

The pieces were screwed together into lengths of about 100 feet, and these lengths again connected by ball and socket joints, so as to admit of being deflected in any direction from the line of pipe at least 25°.

The outer end of this pipe was connected to an appliance consisting of a pipe with laterals and 3 vertical bells coming up to within 8 feet of the surface of the water; each of these bells had a diameter of 16 inches, and were protected by strainers.

Over the pipe, near the intake, piles were driven and planks fastened to them, to make a platform, so that the intake could be lifted out of the water by means of the ball and socket joint, and the strainers examined at any time from this platform.

The reservoir was constructed 320 feet above the surface of the water in the lake. Its dimensions were 112 feet by 120 feet inside and 12 feet deep. It was impossible to get a plot large enough anywhere

that was nearly level, so that there were about 11,500 cubic yards of excavation, and the last 2 feet were so hard as to almost resist the pick.

The walls were 12 feet deep, 6 feet wide at the bottom and 3 feet at the top; they were constructed of rubble masonry, laid in hydraulic cement. The masonry was composed of sound, well shaped and durable stone, found in the vicinity of Penn Yan. No stone was less than 5 inches nor more than 12 inches in thickness. They were laid in full beds of hydraulic cement mortar, composed of one part by measure of freshly burned Rosendale cement, mixed dry with 2 parts of clean sharp sand; afterwards, enough water was added to make the mortar work freely under the trowel, and into all interstices between the stones. The faces of the walls were made true and even by flushing and pointing the joints with mortar.

A bed of hydraulic cement concrete, 1 foot in thickness, was laid on the bottom of the reservoir, and extended 1 foot outside the walls all around, and under the gate chamber it had a depth of 2 feet. The concrete was made of 1 measure of hydraulic cement and 2 of clean, sharp sand, mixed dry, and then just enough water added to make a mortar.

Broken stones, small enough to pass through a ring 2 inches in diameter, free from dust and dirt, were incorporated with the mortar so as to give a surplus of mortar when rammed—the proportion not to exceed 1 of mortar to $2\frac{1}{2}$ of broken stone, the concrete was laid in layers of 6 inches, and was expeditiously rammed and compacted.

The interior surfaces of the walls were plastered to a thickness of 1 inch from bottom to top with Portland cement mortar, composed of 1 part by measure of the best imported Portland cement and 1 part of clean, sharp sand.

The soil of Penn Yan is a sandy loam, so that no rock or hard pan was encountered.

There were 27,500 lineal feet of 4 inch pipe, 17,300 lineal feet of 6 inch pipe, 5,400 lineal feet of 8 inch pipe, 3,000 lineal feet of 10 inch pipe, 7,500 lineal feet of 12 inch pipe, making a total length of 11.5 miles.

The weights per running foot of the cast-iron pipe, including hubs and spiggots, were as follows:—

150	net tons	4	in.	c. i.	pipe,	20	lbs.	per ft.
170	"	" 4	"	"	"	22	"	" "
140	"	" 6	"	"	"	30	"	" "
100	"	" 6	"	"	"	33	"	" "
90	"	" 8	"	"	"	43	"	" "
120	"	" 10	"	"	"	65	"	" "
185	"	" 12	"	"	"	75	"	" "

There were also 15 net tons special castings, 85 double nozzle, 4 in. fire hydrants, 5 double nozzle fire hydrants, 6 in. connection, 10 three way fire hydrants with secondary gate, 6 in. connection.

41— 4 in. gate valves.
38— 6 " " "
15— 8 " " "
9—10 " " "
8—12 " " "
111 gate boxes and stones.

The engines were built by Worthington; there are two of them, capacity 750,000 gallons per day. Non-condensing engines were used because, from all the figures attainable, there did not seem to be sufficient saving of fuel to warrant the additional cost of condensing engines. In larger sized engines there is of course no question about the advantage and economy of using condensers.

There are two boilers made by Aimes.

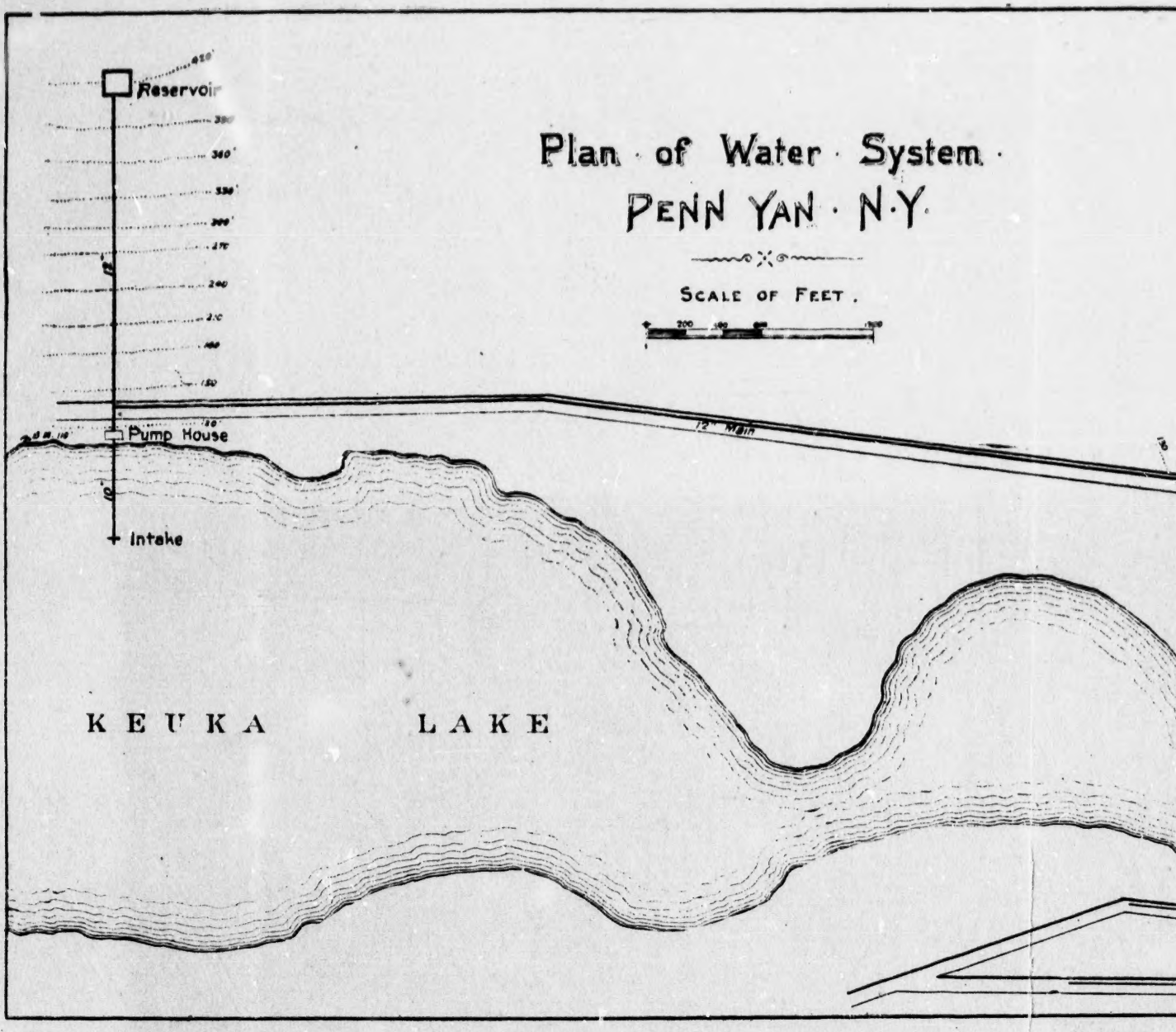
The assessed value of Penn Yan, $1,800,000. The commissioners purposely avoided having a sinking fund, as they did not wish to have

the care and responsibility of it, this they could not have avoided had they issued bonds to be sold on the general market; but they borrowed money from the Comptroller of the State, and are to make annual payments on the same.

Penn Yan has not as yet a sewerage system, although surveys were made for the same at the time of putting in the waterworks.

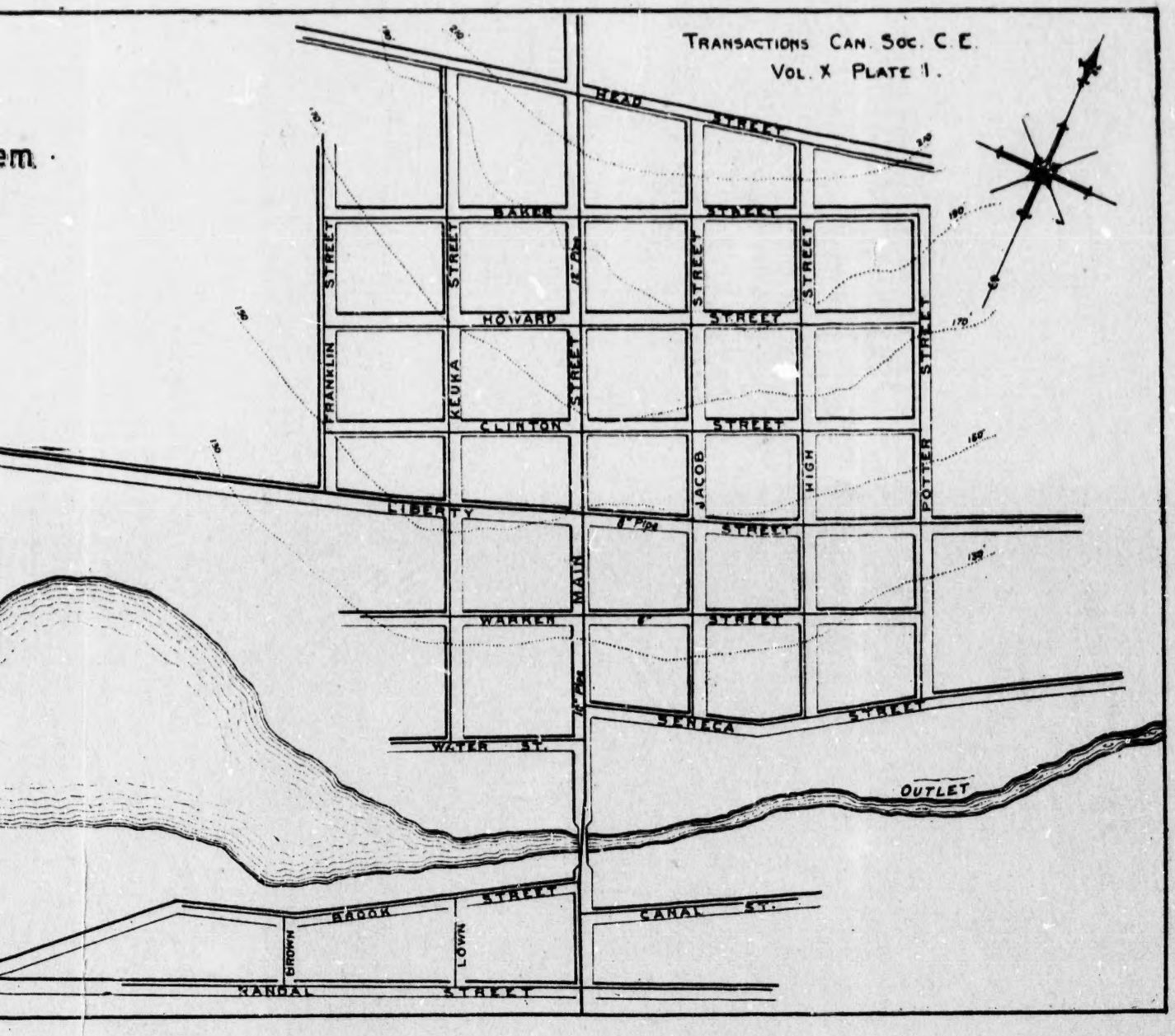
The entire system proved very satisfactory when completed. The accompanying plan shows the relative position of the town, lake and reservoir.

RIDGETOWN, ONT., 9th December, 1895.



Plan of Water System
PENN YAN · N.Y.

SCALE OF FEET.


TRANSACTIONS CAN. SOC. C.E.
VOL. X PLATE 1.
HEAD STREET
BAKER STREET
HOWARD STREET
CLINTON STREET
LIBERTY STREET
WARREN STREET
SENECA STREET
WATER ST.
OUTLET
CANAL ST.
RANDAL STREET
FRANKLIN STREET
KEUKA STREET
MAIN STREET
JACOB STREET
HIGH STREET
POTTER STREET
BROWN STREET
LOWN STREET
BADOK STREET